

Amendments to the Claims:

1. (Presently Amended) An internal combustion engine containing a combustion chamber, comprising:

an engine body including an engine cylinder, a cylinder head forming an inner face of the combustion chamber and at least one intake port formed in the cylinder head for directing intake air into the combustion chamber, the intake air undergoing a swirling effect during operation, ~~said swirling effect~~ resulting [[is]] in a swirl ratio SR in the range of .5 – 2.5;

a piston positioned for reciprocal movement in said engine cylinder between a bottom dead center position and a top dead center position, said piston including a piston crown including a top face facing the combustion chamber, said piston crown containing a piston bowl formed by an outwardly opening cavity, said piston bowl including a projecting portion having a distal end and an inner bowl floor section extending inwardly at an inner bowl floor angle α in the range of 16 – 40 degrees from a plane perpendicular to an axis of reciprocation of the piston, said piston bowl further including an outwardly flared outer bowl section having a concave curvilinear shape in cross section wherein said concave curvilinear shape of said outwardly flared outer bowl section has a radius of curvature R_1 in the range of 8 – 20 mm; and

an injector mounted on the engine body adjacent said projecting portion of said piston bowl to inject fuel into the combustion chamber, said injector including a plurality of orifices arranged to form a spray plume, each of said plurality of orifices having a central axis oriented at a spray angle β from a plane perpendicular to the axis of reciprocation of the piston sufficient to cause the spray plume to impinge on said inner bowl floor section, each of said plurality of orifices including an outlet opening having a center, said center being a distance L_1 in the range of .5 – 4 mm from said distal end of said projecting portion, ~~said distance L_1 being in the range of .5 – 4 mm.~~

2. (New) An internal combustion engine containing a combustion chamber, comprising:

an engine body including an engine cylinder, a cylinder head forming an inner face of the combustion chamber and at least one intake port formed in the cylinder head for

directing intake air into the combustion chamber, the intake air undergoing a swirling effect during operation to result a swirl ratio SR in the range of 0.5-2.5;

a piston positioned for reciprocal movement in said engine cylinder between a bottom dead center position and a top dead center position, said piston including a piston crown including a top face facing the combustion chamber, said piston crown containing a piston bowl formed by an outwardly opening cavity, said piston bowl including a projecting portion having a distal end, an inner bowl floor section extending inwardly, and an outwardly flared outer bowl section having a concave curvilinear shape in cross section, said concave curvilinear shape of said outwardly flared outer bowl section having a radius of curvature R_1 in the range of 8-20 mm; and

an injector mounted on the engine body adjacent said projecting portion of said piston bowl to inject fuel into the combustion chamber, said injector including a plurality of orifices arranged to form a spray plume that impinges on said inner bowl floor section, each of said plurality of orifices including an outlet opening having a center, said center being a distance L_1 of at least 0.5 mm from said distal end of said projecting portion of said piston bowl.

3. (New) The engine of claim 2, wherein said inner bowl floor section extends inwardly at an inner bowl floor angle α degrees in the range of 16-40 degrees from a plane perpendicular to an axis of reciprocation of the piston.

4. (New) The engine of claim 3, wherein each of said plurality of orifices has a central axis oriented at a spray angle β from a plane perpendicular to the axis of reciprocation of the piston, said spray angle β being equal to a value to cause the spray angle β minus the inner bowl floor angle α to be in the range of 0-19 degrees.

5. (New) The engine of claim 2, wherein a distance L_2 between said center of said outlet opening and said inner face of said cylinder head that forms said combustion chamber is in the range of -0.5-3 mm.

6. (New) The engine of claim 2, wherein a distance BH between the top face of the piston crown and said center of said outlet opening is in the range of 0.5-8 mm.

7. (New) An internal combustion engine containing a combustion chamber, comprising:

an engine body including an engine cylinder, a cylinder head forming an inner face of the combustion chamber and at least one intake port formed in the cylinder head for directing intake air into the combustion chamber, the intake air undergoing a swirling effect during operation that results in a swirl ratio SR in the range of 0.5-2.5;

a piston positioned for reciprocal movement in said engine cylinder between a bottom dead center position and a top dead center position, said piston including a piston crown including a top face facing the combustion chamber, said piston crown containing a piston bowl formed by an outwardly opening cavity, said piston bowl including a projecting portion having a distal end, an inner bowl floor section extending inwardly, and an outwardly flared outer bowl section having a concave curvilinear shape in cross section, said concave curvilinear shape of said outwardly flared outer bowl section having a radius of curvature R_1 in the range of 8-20 mm; and

an injector mounted on the engine body adjacent said projecting portion of said piston bowl to inject fuel into the combustion chamber, said injector including a plurality of orifices arranged to form a spray plume that impinges on said inner bowl floor section, each of said plurality of orifices including an outlet opening having a center, said center of said outlet opening being a distance L_2 in the range of -0.5-3 mm from said inner face of said cylinder head that forms said combustion chamber.

8. (New) The engine of claim 7, wherein said inner bowl floor section extends inwardly at an inner bowl floor angle α degrees in the range of 16-40 degrees from a plane perpendicular to an axis of reciprocation of the piston.

9. (New) The engine of claim 8, wherein each of said plurality of orifices has a central axis oriented at a spray angle β from a plane perpendicular to the axis of reciprocation of the piston, said spray angle β being equal to a value to cause the spray angle β minus the inner bowl floor angle α to be in the range of 0-19 degrees.

10. (New) The engine of claim 7, wherein a distance BH between the top face of the piston crown and said center of said outlet opening is in the range of 0.5-8 mm.

11. (New) An internal combustion engine containing a combustion chamber, comprising:

an engine body including an engine cylinder, a cylinder head forming an inner face of the combustion chamber and at least one intake port formed in the cylinder head for directing intake air into the combustion chamber, the intake air undergoing a swirling effect during operation to result in a swirl ratio SR in the range of 0.5-2.5;

a piston positioned for reciprocal movement in said engine cylinder between a bottom dead center position and a top dead center position, said piston including a piston crown including a top face facing the combustion chamber, said piston crown containing a piston bowl formed by an outwardly opening cavity, said piston bowl including a projecting portion having a distal end, an inner bowl floor section extending inwardly, and an outwardly flared outer bowl section having a concave curvilinear shape in cross section; and

an injector mounted on the engine body adjacent said projecting portion of said piston bowl to inject fuel into the combustion chamber, said injector including a plurality of orifices arranged to form a spray plume that impinges on said inner bowl floor section, each of said plurality of orifices including an outlet opening having a center, said center of said outlet opening being a distance BH in the range of 0.5-8 mm from the top face of the piston crown, and being a distance L_1 of at least 0.5 mm from said distal end of said projecting portion of said piston bowl.

12. (New) The engine of claim 11, wherein said inner bowl floor section extends inwardly at an inner bowl floor angle α degrees in the range of 16-40 degrees from a plane perpendicular to an axis of reciprocation of the piston.

13. (New) The engine of claim 12, wherein each of said plurality of orifices has a central axis oriented at a spray angle β from a plane perpendicular to the axis of reciprocation of the piston, said spray angle β being equal to a value to cause the spray angle β minus the inner bowl floor angle α to be in the range of 0-19 degrees.

14. (New) The engine of claim 11, wherein a distance L_2 between said center of said outlet opening and said inner face of said cylinder head that forms said combustion chamber is in the range of -0.5-3 mm.

15. (New) An internal combustion engine containing a combustion chamber, comprising:

an engine body including an engine cylinder, a cylinder head forming an inner face of the combustion chamber and at least one intake port formed in the cylinder head for directing intake air into the combustion chamber, the intake air undergoing a swirling effect during operation to result in a swirl ratio SR in the range of 0.5-2.5;

a piston positioned for reciprocal movement in said engine cylinder between a bottom dead center position and a top dead center position, said piston including a piston crown including a top face facing the combustion chamber, said piston crown containing a piston bowl formed by an outwardly opening cavity, said piston bowl including a projecting portion having a distal end, an inner bowl floor section extending inwardly, and an outwardly flared outer bowl section having a concave curvilinear shape in cross section; and

an injector mounted on the engine body adjacent said projecting portion of said piston bowl to inject fuel into the combustion chamber, said injector including a plurality of orifices arranged to form a spray plume that impinges on said inner bowl floor section, each of said plurality of orifices including an outlet opening having a center, said center of said outlet opening being a distance BH in the range of 0.5-8 mm from the top face of the piston crown, and being a distance L_2 in the range of -0.5-3 mm from said inner face of said cylinder head that forms said combustion chamber.

16. (New) The engine of claim 15, wherein said inner bowl floor section extends inwardly at an inner bowl floor angle α degrees in the range of 16-40 degrees from a plane perpendicular to an axis of reciprocation of the piston.

17. (New) The engine of claim 16, wherein each of said plurality of orifices has a central axis oriented at a spray angle β from a plane perpendicular to the axis of

reciprocation of the piston, said spray angle β being equal to a value to cause the spray angle β minus the inner bowl floor angle α to be in the range of 0-19 degrees.

18. (New) An internal combustion engine containing a combustion chamber, comprising:

an engine body including an engine cylinder, a cylinder head forming an inner face of the combustion chamber and at least one intake port formed in the cylinder head for directing intake air into the combustion chamber;

a piston positioned for reciprocal movement in said engine cylinder between a bottom dead center position and a top dead center position, said piston including a piston crown including a top face facing the combustion chamber, said piston crown containing a piston bowl formed by an outwardly opening cavity, said piston bowl including a projecting portion having a distal end, an inner bowl floor section extending inwardly, and an outwardly flared outer bowl section having a concave curvilinear shape in cross section, said concave curvilinear shape of said outwardly flared outer bowl section having a radius of curvature R_1 in the range of 8-20 mm; and

an injector mounted on the engine body adjacent said projecting portion of said piston bowl to inject fuel into the combustion chamber, said injector including a plurality of orifices arranged to form a spray plume that impinges on said inner bowl floor section, each of said plurality of orifices including an outlet opening having a center, said center of said outlet opening being a distance BH in the range of 0.5-8 mm from the top face of the piston crown, and being a distance L_1 of at least 0.5 mm from said distal end of said projecting portion of said piston bowl.

19. (New) The engine of claim 18, wherein said inner bowl floor section extends inwardly at an inner bowl floor angle α degrees in the range of 16-40 degrees from a plane perpendicular to an axis of reciprocation of the piston.

20. (New) The engine of claim 19, wherein each of said plurality of orifices has a central axis oriented at a spray angle β from a plane perpendicular to the axis of reciprocation of the piston, said spray angle β being equal to a value to cause the spray angle β minus the inner bowl floor angle α to be in the range of 0-19 degrees.

21. (New) An internal combustion engine containing a combustion chamber, comprising:

an engine body including an engine cylinder, a cylinder head forming an inner face of the combustion chamber and at least one intake port formed in the cylinder head for directing intake air into the combustion chamber;

a piston positioned for reciprocal movement in said engine cylinder between a bottom dead center position and a top dead center position, said piston including a piston crown including a top face facing the combustion chamber, said piston crown containing a piston bowl formed by an outwardly opening cavity, said piston bowl including a projecting portion having a distal end, an inner bowl floor section extending inwardly, and an outwardly flared outer bowl section having a concave curvilinear shape in cross section, said concave curvilinear shape of said outwardly flared outer bowl section having a radius of curvature R_1 in the range of 8-20 mm; and

an injector mounted on the engine body adjacent said projecting portion of said piston bowl to inject fuel into the combustion chamber, said injector including a plurality of orifices arranged to form a spray plume that impinges on said inner bowl floor section, each of said plurality of orifices including an outlet opening having a center, said center of said outlet opening being a distance BH in the range of 0.5-8 mm from the top face of the piston crown, and being a distance L_2 in the range of -0.5-3 mm from said inner face of said cylinder head that forms said combustion chamber.

22. (New) The engine of claim 21, wherein said inner bowl floor section extends inwardly at an inner bowl floor angle α degrees in the range of 16-40 degrees from a plane perpendicular to an axis of reciprocation of the piston.

23. (New) The engine of claim 22, wherein each of said plurality of orifices has a central axis oriented at a spray angle β from a plane perpendicular to the axis of reciprocation of the piston, said spray angle β being equal to a value to cause the spray angle β minus the inner bowl floor angle α to be in the range of 0-19 degrees.

24. (New) An internal combustion engine containing a combustion chamber, comprising:

an engine body including an engine cylinder, a cylinder head forming an inner face of the combustion chamber and at least one intake port formed in the cylinder head for directing intake air into the combustion chamber, the intake air undergoing a swirling effect during operation to result in a swirl ratio SR in the range of 0.5-2.5;

a piston positioned for reciprocal movement in said engine cylinder between a bottom dead center position and a top dead center position, said piston including a piston crown including a top face facing the combustion chamber, said piston crown containing a piston bowl formed by an outwardly opening cavity, said piston bowl including a projecting portion having a distal end, an inner bowl floor section extending inwardly, an outwardly flared outer bowl section having a concave curvilinear shape in cross section, said concave curvilinear shape of said outwardly flared outer bowl section having a radius of curvature R_1 in the range of 8-20 mm; and

an injector mounted on the engine body adjacent said projecting portion of said piston bowl to inject fuel into the combustion chamber, said injector including a plurality of orifices arranged to form a spray plume that impinges on said inner bowl floor section, each of said plurality of orifices including an outlet opening having a center, a distance BH between the top face of the piston crown and said center of said outlet opening being in the range of 0.5-8 mm.

25. (New) The engine of claim 24, wherein said inner bowl floor section extends inwardly at an inner bowl floor angle α degrees in the range of 16-40 degrees from a plane perpendicular to an axis of reciprocation of the piston.

26. (New) The engine of claim 25, wherein each of said plurality of orifices has a central axis oriented at a spray angle β from a plane perpendicular to the axis of reciprocation of the piston, said spray angle β being equal to a value to cause the spray angle β minus the inner bowl floor angle α to be in the range of 0-19 degrees.